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3.2.0 Analysis of Technical Specifications – Unit 2

Learning Objectives:

1. Explain the significance of limiting conditions for operation in the areas of applicability, reactivity control systems, instrumentation, the reactor coolant system, and the emergency core cooling systems.
2. When given an initial set of operating conditions, use technical specifications to determine the appropriate plant and/or operator response.

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3.2.1 Introduction

This section is the second of four technical specification sections. This section presents the limiting conditions for operation (LCOs), bases for LCOs, and applications of requirements during different situations for the following technical specification areas:

- Applicability,
- Reactivity control systems,
- Instrumentation,
- The reactor coolant system (RCS), and
- Emergency core cooling systems (ECCSs).

The limiting conditions for operation for these areas identify the minimum performance levels for equipment required to ensure safe operation.

3.2.2 Applicability

The applicability LCOs (also commonly referred to as "motherhood" LCOs) establish the general requirements applicable to all LCOs. The applicability LCOs may be summarized as follows:

- LCO 3.0.1 - Compliance with a particular LCO is required during the operational MODES or other conditions specified in the LCO's applicability statement.
- LCO 3.0.2 - Satisfying the requirements of an LCO or its associated required ACTIONS within the specified time interval(s) constitutes compliance with the specification.

  Together, LCOs 3.0.1 and 3.0.2 indicate that there are three ways to comply with any LCO:

  Meet the LCO (without having to resort to an ACTION requirement), or

  Meet the required ACTIONS of an associated condition, or

  Be in a MODE or other specified condition in which the LCO does not apply.

  There are also five special conditions when it is acceptable to do none of these three. These conditions are described by LCOs 3.0.5, 3.0.6, 3.0.7, 3.0.8, and 3.0.9.

- LCO 3.0.3 - When an LCO and its associated required ACTIONS cannot be satisfied because of circumstances beyond those addressed in the specification's ACTIONS table, action must be initiated to place the unit in an operational MODE in which the specification does not apply, in accordance with specified time intervals. According to the basis for LCO 3.0.3, "This means that no combination of Conditions stated in the ACTIONS can be made that exactly corresponds to the actual condition of the unit. Sometimes, possible combinations of Conditions are such that entering LCO 3.0.3 is warranted; in such cases, the ACTIONS specifically state a Condition corresponding to such combinations and also that LCO 3.0.3 be entered immediately."

- LCO 3.0.4. - When an LCO is not met, entry into a MODE or other specified condition in the Applicability shall only be made:

  1. When the associated ACTIONS permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time;
  2. In accordance with the plant's risk management program, or;
  3. When an allowance is stated in the individual value, parameter, or other Specification.

  It is always acceptable to shut down the plant or comply with an ACTION requirement.

- LCO 3.0.5 - Equipment removed from service or declared inoperable to comply with ACTIONS may be returned to service under administrative control solely to perform testing required to demonstrate its OPERABILITY or the OPERABILITY of other equipment.

  Sometimes, the only way to demonstrate OPERABILITY after maintenance is to place the plant in a condition that is prohibited by required ACTIONS. In this case, LCO 3.0.5 allows the otherwise prohibited condition to exist for the sole purpose of demonstrating OPERABILITY.

- LCO 3.0.6 - When the LCO for a supported system is not met solely due to the LCO for a support system not being met, the required ACTIONS for the supported system are not required to be entered. Only the required ACTIONS for the support system LCO are required to be entered. Entry into the required ACTIONS of the LCO for the supported system may be required, however, if a loss of safety function is determined to exist.

  This is often called the cascading rule. "Cascading" means that the loss of one system leads to the subsequent inoperability of other systems. For example, if one train of the service water system is inoperable, then, by the definition of OPERABILITY, every train and component that relies on cooling by that service water train is also inoperable. But LCO 3.0.6 says that it is not necessary to cascade, i.e., it is not necessary to also enter the required actions for the supported trains and components, unless the required ACTIONS of the service water system LCO specifically require it.

  It is possible that some equipment other than a service water train is also inoperable, and the combination of inoperable equipment causes the loss of a safety function. (For example, a loss of the low pressure injection (LPI) safety function would result if the train 'B' LPI pump were already inoperable and the train 'A' LPI pump is subsequently rendered inoperable by the inoperability of service water train 'A.') In that case, one would cascade (apply the required ACTIONS for the affected supported systems).

- LCO 3.0.7 – Test Exception LCO 3.1.8 allows specified TS requirements to be suspended to permit performance of special tests and operations.

- LCO 3.0.8 – When one or more required snubbers are unable to perform their associated support function(s), any affected supported LCO(s) are not required to be declared not met solely for this reason if the conditions of this specification are met.
- LCO 3.0.9 – When one or more required barriers are unable to perform their associated support function(s), any affected supported LCO(s) are not required to be declared not met solely for this reason if the conditions of this specification are met.

As an example of how applicability LCOs apply to unit operation, consider ECCS LCO 3.5.2. LCO 3.0.1 says that if the unit is in MODE 4, this specification contains no requirements. (LCO 3.5.2 is applicable in MODES 1, 2, and 3 only.) LCO 3.0.2 says that if the unit is in MODE 1, 2, or 3 and one train is inoperable, the required ACTION must be followed (fix it within 72 hours or shut down). LCO 3.0.3 requires that if both ECCS trains are inoperable (a state of inoperability described in condition C), action must be taken within one hour to place the plant in a condition in which the LCO does not apply. LCO 3.0.4 says that the unit's MODE may be changed from MODE 4 to MODE 3 when the LCO is not met if it can be done in accordance with the licensee's configuration risk management program. LCO 3.0.5 says that if the only way to demonstrate OPERABILITY of an ECCS component is to place the plant in a condition that contradicts a required ACTION, the demonstration of OPERABILITY is allowed. LCO 3.0.6 says that if the only problem with the ECCS trains is the loss of a support system (e.g., a component cooling water train), both ECCS trains are still OPERABLE. LCO 3.0.7 does not apply to any ECCS specifications. LCO 3.0.8 allows the ECCS to remain operable with inoperable snubbers if the conditions of LCO 3.0.8 are met. LCO 3.0.9 allows the ECCS to remain operable with inoperable barriers if the conditions of LCO 3.0.9 are met.

Just as the applicability LCOs are the general rules for LCO compliance, applicability surveillance requirements (SRs) are the general rules for performance of surveillance requirements.

- SR 3.0.1 - Surveillance requirements apply when the associated LCO applies. As soon as the licensee discovers that the requirements of a surveillance cannot be met, the LCO is not met (apply LCO 3.0.2).
- SR 3.0.2 - Generally, the surveillance interval can be extended to 1.25 times the interval specified in the frequency. There are two instances in which the interval cannot be extended.

    1. If the frequency is specified as "once" (e.g., once within four hours of a specified event), the interval may not be extended.
    2. If the performance interval applies to a required ACTION that is performed on a periodic or cyclic basis, the interval for the first performance cannot be extended. This type of required ACTION can be viewed as a "surveillance-like" requirement, and its completion time is specified as "once per...." For

example, assume that a periodic ACTION is required once per 12 hours after an instrumentation channel failure. The first performance of the ACTION must be done within 12 hours; the interval for the first performance is not extended. Subsequent performance intervals may be extended.

- SR 3.0.3 - If a surveillance is missed and the allowed interval has expired, the affected equipment is not immediately declared inoperable. A delay period is allowed for the performance of the missed surveillance. The delay may be up to 24 hours or the surveillance interval, whichever is greater. The risk of surveillance delay greater than 24 hours will be managed by the plant's risk management program.
- SR 3.0.4 - An LCO's surveillances must have been met before the unit enters a MODE in which that LCO applies. LCO 3.0.4 requires equipment to be OPERABLE prior to making a corresponding MODE change. SR 3.0.4 says that this OPERABILITY is demonstrated by a current surveillance. The surveillance is current when is has been performed within the specified interval prior to the associated MODE change. If a surveillance is not current, the MODE change shall only be made in accordance with LCO 3.0.4.

As an example of how the applicability SRs apply to unit operation, consider ECCS LCO 3.5.2. SR 3.0.1 says that SR 3.5.2.1 (valve position verification) must be satisfied every 12 hours when the unit is in MODE 1, 2 or 3. If the licensee learns that a valve is not in its required position, the LCO is not met, even if the surveillance is not due to be performed. SR 3.0.2 says that, for operational flexibility, a performance of SR 3.5.2.1 can be as much as 15 hours after the previous performance (12 hours x 1.25). SR 3.0.3 says that if the licensee discovers that the performance interval for SR 3.5.2.1 has inadvertently expired, the licensee does not have to declare that LCO 3.5.2 is not met as long as the surveillance is met within 24 hours of discovery.
SR 3.0.4 says that SR 3.5.2.1 must be met within the 12 hours (plus extension allowed by 3.0.2) prior to the transition from MODE 4 to MODE 3 or else the MODE change must be in accordance with LCO 3.0.4.

3.2.3 Reactivity Control Systems

3.2.3.1 Shutdown Margin

The LCO addressing the minimum SHUTDOWN MARGIN ensures that the reactor can be made subcritical from all operating conditions, transients, and design-basis accidents; that postulated reactivity transients during accidents are controllable within acceptable limits; and that inadvertent criticality during a shutdown condition is precluded. For a subcritical reactor, satisfaction of the LCO requiring an adequate SHUTDOWN MARGIN is verified by a reactivity balance calculation. There is no SHUTDOWN MARGIN LCO for a critical reactor, since this is ensured by verifying that the rod insertion limits are satisfied.

3.2.3.2 Core Reactivity

Accurate prediction of core reactivity is either an explicit or implicit assumption in safety analyses. Large differences between actual and predicted core reactivity may indicate that the assumptions of the design-basis accident and transient analyses are no longer valid. Hence, verifying relative agreement between measured and predicted values of core reactivity ensures that plant operation is maintained within the assumptions of the safety analyses.

3.2.3.3 Moderator Temperature Coefficient

The LCO limits for the moderator temperature coefficient (MTC) ensure that the MTC values are within the bounds assumed in the accident analyses and that inherently stable power operations result during normal operation and accidents. Both the most positive value and the most negative value of the MTC are important to safety; the most positive allowed value limits the consequences of accidents that cause core overheating, and the most negative allowed value limits the consequences of accidents that cause core overcooling.

3.2.3.4 Rod Alignment and Position Indication

The limits on shutdown and control rod alignments ensure that the assumptions in the safety analyses remain valid. Maximum rod misalignment is an initial assumption in the safety analyses that directly affects core power distributions and the available SHUTDOWN MARGIN. The requirement concerning rod OPERABILITY ensures that upon a reactor trip, the assumed reactivity is available and inserted. In addition to ensuring a sufficient SHUTDOWN MARGIN, the rod insertion limits ensure that acceptable power distributions are maintained and that the potential effects of a rod ejection accident are limited. The control bank sequence and overlap limits provide uniform rates of reactivity insertion and withdrawal and maintain acceptable power peaking during control bank motion. In order to ensure that the shutdown and control rods can satisfy these bases, rod position indication must be available and accurate. The OPERABILITY of two rod position indication systems ensures that inoperable, misaligned, or mispositioned rods can be detected.

3.2.3.5 Test Exceptions

The test exception LCOs allow specified LCO requirements to be suspended to permit the performance of special tests and operations. The requirements of the LCOs concerning rod group alignment limits, shutdown and control bank insertion limits, AXIAL FLUX DIFFERENCE, QUADRANT POWER TILT RATIO, moderator` temperature coefficient, and RCS minimum temperature for criticality may be suspended during the performance of PHYSICS TESTS. The MODE 2 SHUTDOWN MARGIN requirements may be suspended during the measurement of control rod worths and SHUTDOWN MARGIN.

3.2.4 Instrumentation

3.2.4.1 Reactor Trip and Engineered Safety Feature Actuation System Instrumentation

The reactor trip system (RTS) initiates a unit shutdown, based on the values of selected unit parameters, to protect against violating the reactor core and RCS pressure safety limits during anticipated operational occurrences and to assist the engineered safety feature (ESF) systems in mitigating accidents. The engineered safety feature actuation system (ESFAS) initiates necessary ESF systems, based on the values of selected unit parameters, to protect against violating the safety limits and to mitigate accidents. The OPERABILITY of the RTS and ESFAS instrumentation and interlocks ensures that:

- The associated reactor trip/ESF action will be initiated when required,
- The specified coincidence logic is maintained, and
- Sufficient redundancy is maintained to permit a channel to be out of service for testing or maintenance.

The LCOs for the RTS and ESFAS instrumentation include extensive tables which identify the applicable MODES and conditions, the required channels, the action requirements, the surveillance requirements, and the trip setpoint for each reactor trip/ESF actuation function. Detailed discussions of the reasons for each function are provided in the bases for these LCOs.

3.2.4.2 Monitoring and Control Instrumentation

The OPERABILITY of the post-accident monitoring instrumentation ensures that there is sufficient information available on selected unit parameters to monitor and to assess unit status and behavior following an accident. The selected parameters enable the operator to determine whether safety systems are performing their intended functions, to determine the likelihood of a gross breach of the barriers to radioactive release, and to provide early indication of the need to protect the public from an actual or impending release of radioactive materials. This information from the monitoring instrumentation provides the necessary support for the operator to take manual actions for which no automatic control is provided and that are required for safety systems to accomplish their safety functions in response to design-basis accidents.

The OPERABILITY of the remote shutdown system ensures the availability of instrumentation and controls necessary to place and maintain the unit in MODE 3 from a location other than the control room. This capability is necessary to protect against the possibility that the control room becomes inaccessible. The instrumentation and controls are required for core reactivity control, RCS pressure control, decay heat removal, RCS inventory control, and necessary support systems.

3.2.4.3 Other Protection Actuation Instrumentation

The LCO for the loss of power diesel generator (DG) start instrumentation requires that the loss of voltage and degraded voltage functions be OPERABLE for each ESF bus. The availability of these functions ensures that DGs are started to supply power to ESF systems during an accident in which offsite power is lost. The loss of these functions could result in the delay of safety system initiation when required and could lead to unacceptable consequences during accidents.

The containment ventilation isolation instrumentation closes containment isolation valves in certain ventilation systems to isolate the containment atmosphere from the environment so that radioactive release is minimized in the event of an accident. Containment ventilation isolation in response to appropriate signals ensures meeting the containment leakage rate assumptions of the safety analyses and ensures that the calculated accidental offsite radiological doses are below 10 CFR 100 limits.

The LCO requirements for the control room emergency ventilation system (CREVS) actuation instrumentation ensure that normal control room ventilation is isolated and that the CREVS is actuated in response to appropriate signals. These actions maintain the habitability of the control room for the operators stationed there during post-accident operations.

3.2.5 Reactor Coolant System

3.2.5.1 Departure from Nucleate Boiling (DNB) Limits

The LCO limits on pressurizer pressure, RCS average temperature, and RCS total flow rate ensure that the core operates within the limits assumed in the safety analyses. Operating within these limits will result in meeting the departure from nucleate boiling ratio (DNBR) criterion in the event of a DNB-limited transient.

3.2.5.2 RCS Minimum Temperature for Criticality

Compliance with the specified minimum temperature for criticality ensures that the reactor will not be maintained critical at a temperature less than a small band below the hot zero power temperature, which is assumed in safety analyses. This limit also ensures (1) that the plant is operated consistent with the MTC and operating temperature ranges assumed in accident analyses, (2) that protective instrumentation is functioning within the normal operating temperature envelope while the reactor is critical, (3) that pressurizer conditions (saturated with steam bubble) are consistent with those assumed in transient and accident analyses, and (4) that the reactor vessel temperature is greater than the minimum nil ductility reference temperature when the reactor is critical.

3.2.5.3 RCS Pressure and Temperature Limits

Although they are not derived from design-basis accident analyses, the pressure/temperature limits are prescribed during normal operation to avoid encountering pressure, temperature, and temperature rate-of-change conditions that might cause undetected flaws to propagate and cause nonductile failure of the reactor coolant pressure boundary, an unanalyzed condition. Violating the LCO limits places the reactor vessel outside the bounds of the stress analyses and can increase stresses in other pressure boundary components. The limits on pressure, temperature, and heatup and cooldown rates are actually stated in the Pressure and Temperature Limits Report (PTLR), which is referenced by the LCO.

3.2.5.4 RCS Loops

The reactor coolant loop LCOs specify the number of reactor coolant and/or residual heat removal (RHR) loops required to be in service for each operational mode. During power operation all four reactor coolant loops are required to be in service. This requirement ensures that core heat removal is sufficient to maintain the DNBR above the DNBR limit during all normal operations and anticipated transients, and that the safety analysis assumptions for design-basis initial conditions are valid.

During MODE 3 operation with the rod control system capable of rod withdrawal, two reactor coolant loops are required to be in service to mitigate the effects of a power excursion caused by an inadvertent control rod withdrawal. Otherwise, during periods of plant shutdown, two cooling loops are required to be operable, with one of the two loops actually in service. One cooling loop, which can be either a reactor coolant or RHR loop, depending on the operational MODE, provides sufficient decay heat removal during shutdown conditions. Two loops are required to be operable to satisfy single failure considerations. The operation of one reactor coolant or RHR pump also provides proper boron mixing in the RCS.

3.2.5.5 Pressurizer

The pressurizer LCO specifies a maximum water level, which ensures that a steam bubble for pressure control exists. The existence of a steam bubble and saturated conditions in the pressurizer is assumed in accident analyses. The minimum required available capacity of pressurizer heaters ensures that the RCS pressure can be maintained, so that subcooled conditions in the RCS can be maintained and that decay heat can be removed by either forced or natural circulation of the reactor coolant.

3.2.5.6 Overpressure Protection

Two LCOs deal with overpressure protection for the RCS. The first, applicable in MODES 1, 2, and 3 and in MODE 4 with RCS cold-leg temperatures greater than 290°F, requires that all pressurizer safety valves be OPERABLE. The combined capacity of the safety valves is required to limit the reactor coolant pressure to less than 110% of its design value (2750 psia) during certain accidents which tend to increase RCS pressure.

The second overpressure protection LCO, applicable in MODE 4 with any cold-leg temperature less than 290°F, in MODE 5, and in MODE 6 when the reactor vessel head is on, specifies the requirements for the low temperature overpressure protection system. The requirements involve minimizing the coolant input capacity by limiting the number of high head pumps capable of injecting to the RCS and by isolating the accumulators, and having an adequate pressure relief capacity Overpressure protection is particularly critical at low RCS temperatures, where the reactor vessel is more susceptible to brittle failure. The PORV lift setpoints are included in the PTLR; they are updated when RCS pressure/temperature limits are modified as reactor vessel material toughness decreases due to neutron embrittlement.

3.2.5.7 PORVs and PORV Block Valves

The PORV LCO requires that the PORVs and their associated block valves be OPERABLE so that they can be manually operated to depressurize the RCS in response to certain plant transients and events if normal pressurizer spray is not available. In particular, the safety analysis for the steam generator tube rupture event assumes that the PORVs are used to depressurize the RCS in order to terminate primary-to-secondary break flow.

OPERABILITY of each PORV block valve assures the capability to isolate the flow path through a failed-open PORV or a PORV with excessive leakage. A failed-open PORV is, in effect, a small-break LOCA.

3.2.5.8 RCS Leakage and Leakage Detection Instrumentation

A limited amount of LEAKAGE is expected from the RCS; it is limited according to its source. The 10-gpm identified LEAKAGE limitation allows for a limited amount of LEAKAGE from known sources which will not interfere with the detection of unidentified LEAKAGE. Unidentified LEAKAGE is limited to one gpm, which is a reasonable minimum detectable rate that the containment air monitoring and containment sump level monitoring equipment can detect within a reasonable time period. No pressure boundary LEAKAGE is allowed, as it could be indicative of material deterioration of the reactor coolant pressure boundary.

Primary-to-secondary LEAKAGE is limited to 150 gpd through any one steam generator. The 150-gpd limit through any one steam generator is based on the assumption that a single crack leaking at this rate would not propagate to a tube rupture under the stress of a loss of coolant accident (LOCA) or a steam line rupture. The structural integrity of the steam generator tubes is ensured through periodic tube inspections, in accordance with the Steam Generator Tube Surveillance Program specified in the Administrative Controls section of the technical specifications. The intent of the inspections is to detect tube degradation at an early stage, so that degraded tubes can be plugged or repaired before LEAKAGE occurs.

Pressure isolation valves are normally closed valves in series which separate the high pressure RCS from attached low pressure systems. The basis for the limits on pressure isolation valve leakage is the 1975 NRC “Reactor Safety Study,” which identified potential intersystem LOCAs as a significant contributor to the risk of core melt.

The LCO dealing with leakage detection instrumentation requires that instruments of diverse monitoring principles be OPERABLE to provide a high degree of confidence that extremely small leaks are detected in time to allow actions to place the plant in a safe configuration.

3.2.5.9 RCS Specific Activity

The LCO for RCS specific activity ensures that the resulting 2-hour doses at the site boundary will not exceed an appropriately small fraction of 10 CFR 100 limits following a steam generator tube rupture. Operation for a limited time with the specific activity greater than 1.0 μCi/gm DOSE EQUIVALENT I-131 but < 60 μCi/gm DOSE EQUIVALENT I-131 accommodates possible iodine spiking. Iodine spiking is the release of iodine to the RCS through fuel cladding defects following power level or pressure changes.

3.2.6 Emergency Core Cooling Systems

3.2.6.1 Accumulators

The accumulators are assumed available to supply water to the reactor vessel in both the large- and small-break LOCA analyses. Accumulator OPERABILITY helps to ensure that the ECCS acceptance criteria of 10 CFR 50.46 will be met following a LOCA. Four accumulators are required to be OPERABLE to ensure that the contents of three of the accumulators reach the core during a LOCA, in accordance with the assumption that the contents of one accumulator spill through the break. The limits on accumulator contained volume, boron concentration, and nitrogen cover pressure ensure that the assumptions associated with accumulator injection in the safety analyses are met.

3.2.6.2 ECCS Trains

The OPERABILITY of the ECCS trains ensures that sufficient ECCS flow is available during large- and small-break LOCAs and helps to ensure that the ECCS acceptance criteria of 10 CFR 50.46 will be met following a LOCA. Borated ECCS flow also limits the potential for a post-trip return to power following a main steam line break.

In MODES 1, 2, and 3, an ECCS train consists of a centrifugal charging (high head) subsystem, a safety injection (SI) (intermediate head) subsystem, a residual heat removal (low head) subsystem, and an OPERABLE flow path capable of taking suction from the refueling water storage tank (RWST) upon a safety injection signal and transferring suction to the containment sump. In MODE 4, the SI subsystem is not included in an ECCS train. In MODES 1, 2, and 3, two OPERABLE ECCS trains are required, assuming a single failure affecting either train. In MODE 4, only one ECCS train is required; single failures are not considered during this MODE of operation.

3.2.6.3 Refueling Water Storage Tank

Satisfying the requirements for RWST temperature, water volume, and boron concentration ensures that an adequate supply of borated water is available (1) to cool and depressurize the containment in the event of a design-basis accident, (2) to cool and cover the core in the event of a LOCA, (3) to maintain the reactor subcritical following an accident, and (4) to ensure an adequate level in the containment sump to support ECCS and containment spray system operation in the recirculation mode.

3.2.6.4 Seal Injection Flow

The LCO limit on seal injection flow ensures that the flow through the reactor coolant pump seal injection line is low enough to ensure that sufficient centrifugal charging pump injection flow is directed to the RCS via the injection points during an accident.

3.2.7 Exercises

Exercise 1

On May 15, plant maintenance personnel are planning to cycle a PORV block valve. During the course of their preparations, they determine that the last time this surveillance was performed was January 5. All PORVs are OPERABLE.

1. Locate in the technical specifications the requirement for PORV block valve cycling.
2. Identify whether the specified frequency for this surveillance has been exceeded.
3. State the actions to be taken in accordance with technical specification requirements.

Exercise 2

During operation at 100% power, it is discovered that the individual rod position indicator for rod M-12 is inoperable. In addition, the group I step counter for control bank D is out of service (rod M-12 is in group 1 of control bank D). State the actions to be taken in accordance with technical specification requirements.

Exercise 3

With the plant at 85% power, a boration is performed to move control bank D from 200 steps withdrawn to 220 steps withdrawn. When the boration is complete, the operator notices that the group step counter for control bank D is reading 220, the individual rod position indication for rod M-12 (a bank D rod) is 198 steps, and the individual rod position indications for all other bank D rods are 222 steps. State the actions to be taken in accordance with technical specification requirements.

Exercise 4

During operation at 95% power, pressurizer pressure channel PT-455 fails high; the input of the failed channel into the pressurizer pressure control system causes the pressurizer spray valves to open. Pressurizer pressure decreases to 2170 psig before the operator manually shuts the spray valves. The operator declares PT-455 inoperable and changes pressure control functions to another channel. State the actions to be taken in accordance with technical specification requirements.

Exercise 5

During operation at 50% power, the operators detect a small RCS leak. A water inventory balance determines the leak rate to be two gpm.

1. Classify the LEAKAGE.
2. Subsequent to this, RHR pressure response indicates that the leak is though two series 6" check valves in an RHR discharge line. What do technical specifications require at this time?
3. State the actions to be taken in accordance with technical specifications if the leak rate increases to 20 gpm.

Exercise 6

After the drawing of accumulator samples, the volume of accumulator A is determined to be 6470 gallons. State the actions to be taken in accordance with technical specification requirements.

TECHNICAL SPECIFICATIONS UNIT 2 - EXERCISE 1 SOLUTION

1. Locate in the technical specifications the requirement for PORV block valve cycling.

A complete cycle of each PORV block valve is required once every 92 days in accordance with surveillance requirement (SR) 3.4.11.1.

2. Identify whether the specified frequency for this surveillance has been exceeded.

May 15 is 130 days after January 5, so the surveillance has not been performed in the last 130 days. SR 3.0.2 states, “The specified Frequency for each SR is met if the Surveillance is performed within 1.25 times the interval specified in the Frequency, as measured from the previous performance....” The specified interval for this surveillance is 92 days, and 1.25 times the interval is 115 days. Even with the additional 23-day “grace period,” the frequency has been exceeded.

3. State the actions to be taken in accordance with technical specification requirements.

SR 3.0.3 states, “If it is discovered that a Surveillance was not performed within its specified Frequency, then compliance with the requirement to declare the LCO not met may be delayed, from the time of discovery, up to 24 hours or up to the limit of the specified Frequency, whichever is greater. This delay period is permitted to allow performance of the Surveillance.

If the Surveillance is not performed within the delay period, the LCO must immediately be declared not met, and the applicable Condition(s) must be entered.

When the Surveillance is performed within the delay period and the Surveillance is not met, the LCO must immediately be declared not met, and the applicable Condition(s) must be entered.”

The PORV block valve must be cycled within the next 92 days. If the surveillance is not performed within that time, or if the surveillance is not met when performed, then the LCO 3.4.11 conditions for an inoperable PORV must be entered.

State the actions to be taken in accordance with technical specification requirements.

LCO 3.1.7 requires that individual and demand position indicators be OPERABLE.

For the inoperable DRPI for rod M-12, condition A applies. The required actions for this condition specify (1) verifying the position of rod M-12 with the movable incore detectors once every 8 hours (required action A.1), or (2) reducing THERMAL POWER to $\leq$ 50% RTP within 8 hours (required action A.2).

For the inoperable bank D, group 1 demand position indicator, condition D applies. The required actions for this condition specify (1) verifying that all DRPIs for the affected bank are OPERABLE (required action D.1.1) and that the maximum distance between rods in that bank is $\leq$ 12 steps once every 8 hours (required action D.1.2), or (2) reducing THERMAL POWER to $\leq$ 50% RTP within 8 hours (required action D.2).

Because rod M-12 is in control bank D, the OPERABILITY of the DRPIs for all rods in that bank cannot be verified in accordance with required action D.1.1. Therefore, to fulfill the action requirements for both inoperable position indicators, THERMAL POWER must be reduced to $\leq$ 50% RTP within 8 hours.

State the actions to be taken in accordance with technical specifications.

From the statement of the problem, it can be concluded that rod M-12 did not withdraw with the other rods in its bank and that M-12 remains where it was before the boration. LCO 3.1.4 requires that all control rods be OPERABLE and that all individual rod position indications be within 12 steps of their group step counter demand positions. Rod M-12's position (198 steps) is now 22 steps below the bank D, group 1 demand position (220 steps).

Without further evidence, a licensee would be unlikely to declare rod M-12 untrippable, so condition A of LCO 3.1.4 would not be considered applicable.

On the other hand, condition B of LCO 3.1.4 is unquestionably applicable. The required actions for this condition specify (1) restoring rod M-12 to within 12 steps of the bank D, group 1 step counter indication within 1 hour (required action B.1), or (2) taking all of the B.2 required actions, which include reducing THERMAL POWER to ≤ 75% RTP within 2 hours.

One way to comply with the required actions is to insert the other bank D rods to within 12 steps of rod M-12 (assuming that rod M-12 doesn’t move when bank D rods are inserted). This action would satisfy required action B.1 while providing the licensee time to troubleshoot the rod control problem without having to reduce power. A check of Figure COLR-2 reveals that the rod insertion limits would be satisfied for a bank D position between 186 and 210 steps at 85% power.

State the actions to be taken in accordance with technical specification requirements.

Several conditions of LCOs have been entered.

First, the current pressure is less than the DNB pressurizer pressure limit (2205 psig) specified by LCO 3.4.1. Condition A of that LCO applies; pressure must be restored to greater than the limit within 2 hours (required action A.1).

Second, the failed pressurizer pressure channel affects the following reactor trip system functions of LCO 3.3.1: overtemperature ΔT (for which condition D applies), pressurizer pressure - low (for which condition J applies), and pressurizer pressure - high (for which condition D applies). The required actions for conditions D and J both require that the inoperable channel be placed in trip within 72 hours (required actions D.1 and J.1), or that the plant be brought to a condition in which those functions are not required to be OPERABLE (required actions D.2 and J.2).

Third, the failed pressurizer pressure channel affects the following ESFAS functions of LCO 3.3.2: safety injection on pressurizer pressure - low (for which condition D applies) and the P-11 interlock (for which condition K applies). The required actions for condition D require that the inoperable channel be placed in trip within 72 hours (required action D.1), or that the plant be brought to a condition in which that ESFAS function is not required to be OPERABLE (required actions D.2.1 and D.2.2). The required actions for condition K require verification that the interlock is in the required state for 95% power operation (required action K.1), or that the plant be brought to a condition in which the interlock is not required to be OPERABLE (required actions K.2.1 and K.2.2).

In summary:

1. Pressurizer pressure should be restored through either manual or automatic operation of the pressurizer pressure control system.
2. Three reactor trip bistables and one ESFAS bistable associated with pressurizer pressure channel PT-455 should be tripped.
3. The P-11 interlock would be in the required state so long as the other two pressurizer pressure channels which provide inputs to the interlock are indicating the correct pressure.

TECHNICAL SPECIFICATIONS UNIT 2 - EXERCISE 5 SOLUTION

1. Classify the LEAKAGE.

In accordance with the definition for LEAKAGE in the definitions section of the technical specifications, it would be classified as unidentified LEAKAGE.

2. Subsequent to this, RHR pressure response indicates that the leak is though two series 6" check valves in an RHR discharge line. What do technical specifications require at this time?

The LEAKAGE is now specifically located, and it is not pressure boundary. Thus, the LEAKAGE would now be classified as identified LEAKAGE. A condition requiring action has not been entered, as the LCO 3.4.13 limit for identified LEAKAGE is 10 gpm.

3. State the actions to be taken in accordance with technical specifications if the leak rate increases to 20 gpm.

A 20-gpm leak rate exceeds the limit for identified LEAKAGE. Condition A of LCO 3.4.13 applies. The LEAKAGE must be reduced to within limits within 4 hours (required action A.1), or the plant must be brought to MODE 3 within the next 6 hours (required action B.1) and to MODE 5 within the next 36 hours (required action B.2).

Also, LCO 3.4.14 is not met. SR 3.4.14.1 specifies a maximum leakage of 5 gpm. Action condition A.1 must be carried out. This action could be satisfied by isolating the affected RHR line. This isolation would stop the RCS leak, allowing the licensee to exit Condition A of LCO 3.4.13, but RHR operability would have to be evaluated. A required plant shutdown is inevitable.

State the actions to be taken in accordance with technical specification requirements.

The current accumulator volume is outside the acceptable range stated in SR 3.5.1.2 (6508 - 6956 gallons). As a result, condition B of LCO 3.5.1 applies. The accumulator must be restored to OPERABLE status (the water volume of the accumulator must be increased to $\geq$ 6508 gallons) within 24 hour. If the 24-hour completion time is not met, actions must be taken to place the plant in a MODE in which the LCO does not apply, in accordance with the required actions for condition C.

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